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PATTERN OF RENAL DISEASES AMONG HOSPITALIZED CHILDREN IN KHARTOUM STATE

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Dedication

To my mother, sisters and brother

To the soul of my father

To my husband

To my teachers and patients

*To all these for their care, encouragement,
cooperation and great support.*

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ABSTRACT

A prospective, descriptive, hospital based study was conducted during the period from January 2004 to June 2004 on patients admitted to Paediatric and renal units in Khartoum State.

The objectives of the study were to document the pattern and short-term outcome of renal diseases in children admitted to hospitals and to analyze the associated and background factors for different entities of renal diseases.

The study included 150 children aged one day to 18 years with a mean age of 6 years. Male patients were 70% with Male : Female ratio 2.3:1.

Two hundred twenty six renal disease entities were documented in 150 patients, UTI occurred in 57 patients (25.2%), nephrotic syndrome in 34(15.1%), renal stone 31(13.7%), chronic renal failure 30(13.3%), congenital anomalies 28(12.5%), acute glomerulonephritis 24(10.6%), acute renal failure 12 (5.3%), renal tumors 5 (2.2%), renal tubular acidosis 3 (1.3%), nephrocalcinosis 1 (0.4%) and bladder polyp in 1 (0.4%).

The majority of cases with UTI 54(94.7%) occurred in association with other diseases, isolated cases were only 3(5.3%).

65.6% of the patients with nephrotic syndrome were steroid sensitive. The main pathology in children with steroid resistant nephrotic syndrome was focal segmental glomerulosclerosis in 11 (63.6%) biopsied children. A strong correlation was found between high blood pressure and steroid sensitivity, while no significant relation was found between the patient's ages and steroid sensitivity.

Renal stones occurred in 31 patients (13.7%) and it was the main cause of chronic renal failure in our patients (33.3%). A significant correlation was found between patient's ages and the outcome and between the site of stone and renal function.

Chronic renal failure was the final outcome in 30 patients (13.3%) caused mainly by obstructive uropathy due to stones and posterior urethral valve.

Acute renal failure occurred in 12 patients (5.3%) and caused mainly by hypovolemia due to severe dehydration (50.0%).

Congenital urinary tract anomalies were detected in 28(12.5%), with posterior urethral valve being the most common type (35.7%), it is associated with vesicouretric reflux in the majority of patients and it was one of the main causes of CRF in the studied groups (16.7%). No significant correlation was found between the type of congenital anomaly and the renal function.

Post infectious GN was the most common type of acute nephritis (87.5%) and all the patients had full recovery.

Nephroblastoma occurred in 4 patients (1.8%) and Burkitt's lymphoma in one patient (0.4%).

By the end of the study, 91 patient (60.7%) achieved full recovery, 43(28.6%) progressed to a chronic renal problem, 9(6%) died and 7(4.7%) referred to other units (for chemotherapy in patients with tumors).

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List of Abbreviations

ADH	Antidiuretic Hormone
ARF	Acute Renal Failure
CNS	Central Nervous System
CRF	Chronic Renal Failure
DMSA	Dimercaptosuccinic Acid
ESRF	End Stage Renal Failure
FH	Family History
FMF	Familial Mediterranean Fever
FSGS	Focal Segmental Glomerulosclerosis
GFR	Glomerular Filtration Rate
GN	Glomerulonephritis
HIV	Human Immunodeficiency Virus
NS	Nephrotic syndrome
SLE	Systemic Lupus Erythematosus
UTI	Urinary Tract Infection
VUR	Vesicouretric Reflux

Chapter One

1- INTRODUCTION

Medical audit of morbidity pattern is an invaluable tool in health planning in any given community⁽¹⁾, it is important in health care research and resource allocation particularly in economics where financial allocation to health care sector falls short of minimum requirement⁽²⁾.

An audit of renal diseases in children in any environment may provide data that could guide health planners in the developing countries⁽³⁾.

1.1 Structure and Function of the Kidney⁽⁴⁾

The kidneys lie in the retroperitoneal space slightly above the level of the umbilicus and range in length and weight respectively from approximately 6 cm and 24g in the full term newborn to 12 cm or more and 150 g in the adult. The kidney has an outer layer, the cortex, which contains the glomeruli, proximal and distal tubules and the collecting ducts, and an inner layer, the medulla, which contains the straight portions of the tubules, the loops of Henle, the vasa recta and the terminal collecting ducts.

Each kidney contains approximately one million nephrons (glomeruli and associated tubules).

The blood supply to each kidney consist of a main renal artery arises from the aorta which then divides into segmental branches within the medulla and these into interlobar arteries, these give rise to the afferent arterioles of the glomeruli, which divide into the glomerular capillary network which then merges into the efferent arterioles.

The glomerular network of specialized capillaries serves as the filtering mechanism of the kidney, as the blood passes through the glomerular capillaries, the plasma is filtered, the filtrate is then collected in Bowman space and enters the tubules where it's composition is modified in accordance with body needs until it leaves the kidney as urine. Glomerular filtration begins around the 9th week of fetal life, following birth, the rate of glomerular filtration increases until growth ceases toward the end of the 2nd decade of life. The glomerular filtration rate (GFR) of the child does not approximate adult values until the 3rd year of life.

The precise measurement of the GFR is accomplished by quantitating the clearance of a substances that is freely filtered across the capillary wall and that is neither reabsorbed nor secreted by the tubules.

1.2 Classification of Renal Diseases:

Renal diseases can be classified as follows⁽⁵⁾:

- i- Congenital and inherited diseases e.g. renal dysplasia, hypoplasia, and agenesis, syndromes and malformations of the urinary tract, polycystic kidney diseases, renal tubular acidosis and nephrogenic diabetes insipidus.
- ii- Glomerular diseases e.g. acute proliferative glomerulonephritis (GN) and cresenteric nephritis, IgA nephropathy and Henoch-Schonlein nephritis, membranoproliferative GN, membranes GN, steroid-responsive nephrotic syndrome (NS), steroid-resistant idiopathic nephrotic syndrome (NS) and congenital NS.
- iii- Vascular and interstitial diseases: e.g. vasculitis, SLE nephritis, haemolytic-uremic syndrome, tubulointerstitial nephritis.
- iv- Urinary tract disease: e.g. urinary tract infection (UTI), vesicoureteral reflux (VUR) and scarring, obstructive uropathy, nephrocalcinosis and urolithiasis and renal tumors.
- v- Special renal problems e.g. neonatal nephrology, drug nephrotoxicity, infectious diseases and the kidney, HIV nephropathy.

- vi- Hypertension
- vii- Acute and chronic renal failure.

1.2.1 Glomerular diseases:

Glomerular disease constitutes a common cause of end-stage renal disease in many countries. The glomeruli are injured by a variety of external factors, systemic diseases and hereditary diseases^(6,7). All glomerular diseases generally present with a variable range of proteinuria, haematuria, hypertension and impaired renal function⁽⁸⁻¹¹⁾.

The immunologic injury is the most common cause of glomerular disease and result in glomerulonephritis, antibodies are produced against and combines with circulating antigens unrelated to the kidney forming immuno-complexes which then accumulate in the glomeruli and activate the complement system leading to immune injury. The glomerulus has a limited number of histopathologic response to the different mechanism of injury, so different disease states may produce similar microscopic changes e.g. proliferation of glomerular cells associated with an increase in the mesangial matrix which leads to increase in glomerular size and narrow the lamina of glomerular capillaries leading to renal insufficiency, occurs in most forms of GN⁽⁴⁾.

1.2.2 Acute Renal Failure (ARF)

Acute renal failure represents the rapidly progressive (within several months or days) cessations of renal function, which results in the inability of the kidney to control body homeostasis, manifesting in retention of nitrogenous waste products (azotemia), and fluid and electrolyte imbalance⁽¹²⁾.

It has three main causes: pre-renal, renal and post-renal⁽¹³⁾.

The pre-renal causes of ARF e.g. hypovolemia, produce decreased in renal perfusion through decrease in total or effective circulating blood volume leading to decreased GFR.

Renal causes of ARF include the rapidly progressive forms of GN, the haemolytic uremic syndrome which is the most common cause of AFR in toddlers. In acute tubular necrosis (caused by e.g. heavy metals and chemicals), the precise mechanisms of ARF is unknown. Acute interstitial nephritis is a common cause of ARF and is the result of a hypersensitivity reaction to a therapeutic agent, developmental abnormalities and hereditary nephritis may be associated with ARF.

Post renal cause of ARF includes obstructions of the urinary tract.

1.2.3 Chronic Renal Failure (CRF):

In CFR, progressive loss of nephrons causes permanently impaired renal function. Diminished renal reserve is the first stage of CFR, plasma biochemistry is normal and the abnormality in renal function is detected as a decrease in glomerular filtration rate (GFR). Diminished renal reserve become early renal failure at GFR of about 30 ml/min, late renal failure at 10 ml/min and end-stage renal failure (ESRF) at 5 ml/min ⁽¹⁴⁾.

Factors that play important roles in progressive functional deterioration are: (i) ongoing immunologic injury by ongoing depositions of immunocomplexes in the glomeruli leading to persistent glomerular inflammation and eventual scarring.

- (ii) Haemodynamically mediated hyperfiltrations in surviving glomeruli which serves to reserve renal function, may also damage these glomeruli by mechanisms that are not understood.
- (iii) Dietary protein and phosphorus intake: a high protein diet accelerate the development of renal failure perhaps by means of afferent arteriolar dilatation and hyperperfusion injury.
- (iv) Persistent proteinuria and systemic hypertension from any cause may directly damage the glomerular capillary

wall leading to glomerular sclerosis and initiation of hyperfiltration injury.

The cause of CFR in childhood correlates closely with the age of onset, CFR in < 5 years is commonly due to congenital abnormalities e.g. hypoplasia, dysplasia, obstructions, malformations – where as after 5 years of age acquired glomerular diseases (glomerulonephritis) or hereditary disorders e.g. Alport's syndrome predominates⁽¹³⁾.

The incidence rate for ESRF for children 0-19 yrs adjusted for age, race and sex average 10-12/million adjusted population, a rate that hasn't change in more than a decade ⁽¹⁵⁾.

1.2.4 Urinary Tract Infection (UTI):

UTI is one of the commonest bacterial infections in children. Symptomatic UTI occur in 1.4/1000 newborn infant, M > F. Symptomatic and asymptomatic UTI occur in 1.2 – 1.9% of school aged females ⁽¹⁶⁾.

In Goteberg, Sweden, 7.8% of the girls and 1.6% of the boys of school age, were found to have symptomatic UTI verified by urine culture ⁽¹⁷⁾.

Obstructive malformations are found in 2% of girls and 10% of boys investigated for UTI ⁽¹⁸⁾.

In the neonatal period bacteria reach the urinary tract via the blood or urethra, whereas late in life they ascend the urinary tract from below. Bacteria can reach the kidney from the bladder by way of established vesicoureteral reflux or through a transient reflux precipitated by the inflammation of the bladder wall.

Acute pyelonephritis leads to enlargement of the kidney due to oedema and acute inflammatory infiltrate in the medulla and pelvis, if untreated it leads to the formation of renal microabscesses which become confluent causing renal scarring and leading to chronic pyelonephritis. 90% of children with lesion of chronic pyelonephritis have or have had vesicoureteral reflux ⁽¹⁶⁾.

Pyelonephritis scarring is the most common cause of unilateral renal parenchymal disease and is a common cause of hypertension in children and young adults ⁽¹⁹⁻²²⁾. In follow up studies of children with scarring, approximately 6-13% of them develop hypertension ⁽²³⁻²⁶⁾.

Chronic pyelonephritis is also responsible for up to 15% of cases of end-stage renal failure in children ⁽¹⁶⁾.

1.2.5 Congenital malformations:

Renal anomalies are found in approximately 3-6/1000 birth ⁽²⁷⁻²⁹⁾. When adjusted for race, sex and maternal age, data for renal agenesis, cystic kidney, extrophy of the bladder and

obstruction of the bladder or urethra, do not show differences in prevalence between geographic areas ⁽²⁷⁾.

- ***Renal agenesis:*** refers to complete absence of one or both kidneys without identifiable rudimentary tissue, it is usually associated with agenesis of the ipsilateral ureter.

- ***Pathogenesis:*** is failure of formation of the metanephrons, causal heterogeneity has been shown both by animal studies and human observation ⁽³⁰⁻³²⁾, including failure of ureteric bud formation, failure of the bud to reach the metanephric blastema or failure of the bud and the metanephric blastema to create mutual inductive influence on one another.

- *Unilateral renal agenesis* is usually asymptomatic but is associated with an increased frequency of anomalies in the remaining kidney ⁽³³⁻³⁴⁾.

- *Bilateral renal agenesis* results in severe oligohydramnios and fetal or perinatal loss.

- **Dysplasia and polycystic kidney:**

Dysplasia refers to abnormal differentiation or organizations of cells in the tissue; renal dysplasia is characterized histologically by the presence of primitive ducts and rests of metaplastic cartilage ⁽³⁵⁾. It is the most common congenital

urinary tract anomaly and is the most common cause of an abdominal mass in children ⁽²⁹⁾.

The most likely pathogenesis is an error of the mutual induction between the ureteric bud and the metanephric blastema which occurs immediately after the union of the two structures ⁽³⁶⁾.

Polycystic kidney disease is a heritable disorder with diffuse cystic involvement of both kidneys without dysplasia ⁽³⁷⁾.

- **Posterior urethral valve:**

This refers to abnormal mucosal folds that function as a valve to obstruct urine flow; it is the most common childhood cause of obstructive uropathy leading to renal failure.

1.2.6 Renal tumors:

Wilm's tumor: is the most common malignancy or malignant neoplasm in the urinary tract of children, it develops in approximately one child in 100,000 and more than 500 new cases occur annually in the United States ⁽³⁸⁾. Hereditary and bilateral cases occur at a mean age of 2.5% ⁽³⁹⁾. It occurs more in African – American children than in white children ⁽⁴⁰⁻⁴¹⁾ and environmental factors and climate do not affect the incidence of tumor occurrence⁽³⁹⁻⁴⁰⁾.

1.3 Evaluation of Children with Possible Kidney Disease⁽⁴²⁾:

1.3.1 History:

Family History (F.H): A detailed F.H is an essential part of the clinical evaluation. Genetic factors are relevant in a wide variety of renal diseases e.g. inherited disorders of renal tubular function, familial GN and cystic disease of the kidney.

Obstetric and neonatal history: An oedematous placenta, more than 25% of the child birth weight, is a feature of the congenital nephrotic syndrome. Umbilical arterial catheterization may cause vascular damage and subsequent hypertension.

General medical history: Because the kidney or urinary tract is commonly involved in syndromes of congenital malformations or multisystem disorders, attention must be paid to all aspects of the child medical history.

Urine and micturition: A micturition history with specific details about urinary stream and voided volumes is essential. A past history of haematuria or features suggesting UTI may be relevant to the current renal problem.

Dietary history: A review of nutrition and feeding problems should be undertaken. Chronic salt-wasting, a feature of chronic renal failure, is commonly associated with an increased salt appetite and a preference for savory rather than sweet foods.

Gastrointestinal symptoms: A prodrome of diarrhea, strongly suggests infection with a verotoxin producing E.coli as the cause of haemolytic-uremic syndrome.

Psychosocial review: Many children with renal diseases come from families with severe social problems, some disorders e.g. nephritis secondary to skin infection, are more common in deprived social class. The commitment of the family to the child must be assessed, the impact of the disease on the child's intellectual, emotional and social progress must be assessed.

1.3.2 Analysis of symptoms: A renal or urologic disorder may present with symptoms obviously pointing to the urinary tract e.g. haematuria or dysuria, or the kidney may be involved as part of a more widespread syndrome e.g. SLE. Similarly disordered pattern of micturition or change in urine volume or composition may indicate renal pathology, however, serious renal

disease may present without any symptoms at all, or be associated with symptoms and signs unrelated to the urinary tract.

Haematuria: It means the presence of blood in urine, is either macro or microscopic, it may originate from the glomeruli or from the urinary tract. Blood in the initial part of the urinary stream suggest a urethral origin of the bleeding. Terminal haematuria particularly if associated with suprapubic pain or disturbance of micturition points to a bladder cause. If the haematuria is persistent and accompanied by heavy prteinuria or reduced renal function, it is necessary to proceed to renal biopsy to determine the glomerular lesion.

Cloudy offensive urine: This suggests a urinary tract infection (UTI), particularly if associated with local symptoms of dysuria and frequency or systemic symptoms of fever and loin pain. Children with a proven UTI should have abdominal ultrasound to exclude a urologic abnormality. Boys or younger girls or those with recurrent UTI require cystogram to exclude vesicoureteric reflux (VUR), and if it is present, a DMSA scan to determine the extent of renal scarring.

Anuria, oliguria and polyuria: Anuria is the complete suppression of urine.

Oliguria is the passage of an insufficient volume of urine to maintain haemastasis = $< 500 \text{ ml/m}^2/24 \text{ hrs}$. It may represent the physiologic response of a healthy kidney to inadequate perfusion, paranchymal renal disease or obstruction of the urinary tract. Polyuria result from excessive fluid intake, failure of release of ADH, osmotic diuresis or renal resistance to the action of ADH.

Incontinence and enuresis: Diurnal incontinence requires careful evaluation for the possibility of a neuropathic bladder.

Poor urinary stream in a male infant particularly if associated with a full bladder, strongly suggests an obstructive pathology e.g. posterior urethral valve.

Urinary retention: Is an uncommon problem in children and needs urgent attention to exclude a congenital anomaly, neuropathic bladder, tumor or stone.

Frequency and dysuria: Increased frequency ($> 8 \text{ times/day}$) in children 5-14 years, usually associated with other symptoms as urgency, may be due to polyuria, reduced bladder capacity, bladder irritability as with UTI.

Dysuria or painful, passage of urine, usually indicate nephritis or cystitis secondary to UTI.

Oedema: Extracellular fluid expansion result in oedema formation, there are two mechanisms of oedema formation in renal disease: (i) characteristic of acute nephritic syndrome and renal failure is a primary failure to excrete water and salt resulting in oedema. (ii) as in nephrotic syndrome, oedema result from hypoproteinemia which leads to a low oncotic pressure and the passage of fluids from intravascular into the interstitial compartment.

General symptoms: Symptoms associated with uremia are: vague ill health, lassitude, anorexia and vomiting.

Children with chronic renal failure and some renal tubular disorder grow poorly and may present with this problem.

Asymptomatic presentation: Renal diseases are often asymptomatic, only coming to light as a consequence of routine examination or screening programs, this leads to the need of the following:

Antenatal ultrasound: The routine use of diagnostic ultrasound during pregnancy has led to the detection of urologic

abnormalities in many fetuses e.g. simple hydronephrosis, multicystic-dysplastic kidney...etc.

Routine neonatal examination: The routine examination of the neonates should include abdominal palpations which may reveal evidence of renal disease e.g. palpable bladder or renal masses caused by hydronephrosis, cystic disease or tumor.

Renal agenesis or severe dysplasia should be suspected if there is a history of oligohydramnios associated with compression deformities e.g. crumpled ears, potter's facies, dislocated hips or pulmonary hypoplasia.

There is an increased incidence of renal anomalies in association with other congenital defects particularly those of cardiovascular and gastrointestinal tract, genitals and single umbilical artery.

Urine screening programs: because of the association between UTI, vesicoureteric reflux and renal scarring, important role of screening for bacteria to prevent renal damage.

Family studies: The diagnosis of an inherited disorder in a child, particularly if dominant or x-linked, should lead to a review

of the extended family so identify several individuals previously unaware of having a renal abnormality.

1.3.3 Physical examination:

General assessment: A rapid assessment should be made of how sick the child is, whether there is circulatory failure or shock, level of consciousness and the child's state of care. Features suggesting long standing chronic renal failure are growth retardation and skeletal deformities caused by uremic osteodystrophy, so proper assessment of the child growth by accurate measurement of height and weight. Pubertal development must be assessed.

Cardiorespiratory system: The pulse should be examined and the rate, rhythm and volume recorded. The femoral pulses should always be palpated; coarctation of the aorta may present with renal failure and/or hypertension. Auscultations for bruits over major arteries e.g. coarctid and renal may indicate extensive vascular disease or renal artery stenosis.

Frequent observation of the blood pressure is an integral part of the management of the child with renal disease and sustained hypertension in childhood requires full investigations.

In the precordium, cardiomegaly may reflect volume overload or long standing hypertension.

Pericarditis with rub is a feature of severe uremic state.

In the lungs, a rapid respiratory rate with recession with diffuse fine crepitations at both lung bases indicate pulmonary oedema. Hyperventilation suggests metabolic acidosis.

Abdomen: Abdominal distension in relation to renal disease may be a consequence of ascites or renal enlargement because of hydronephrosis, tumor, polycystic or multicystic kidney or retention of urine in the bladder.

Absence of abdominal wall musculature is characteristic of the Prune-Belly syndrome.

Hepatosplenomegaly in association with renal disease occurs in multisystem disorders like SLE or with infections like shunt nephritis or with neoplastic process complicated by uric acid nephropathy.

Enlargement of the bladder should be sought by palpation and percussion. In cases of urinary retention a rectal examination is necessary to exclude a pelvic mass.

Examination of the genitalia for the presence of foreskin in a male, and the position of the urethral opening must be

ascertained in both sexes. Bilateral cryptorchidism is a feature of the Prune-Belly syndrome.

Male pseudohermaphroditism with cryptorchidism is associated with nephroblastoma and glomerular disease in the Denys-Drash syndrome.

Anus: In the neonate, an imperforated or abnormally positioned anal opening may represent one feature of complex congenital abnormalities including those affecting the renal tract.

CNS: Convulsion may be due to uremia, hypertension, hypo or hypernatremia, hypocalcemia or hypomagnesemia.

With a suspected neuropathic bladder, peripheral sensory and motor function must be examined carefully, lower limb power, tone, reflexes and sensation should be tested, the tone of the anal sphincter should be examined.

Eyes: Examination of the eyes offers many clues in the evaluation of renal disease, examples for this: Alport's syndrome may be associated with keratoconus or more commonly with a macular abnormality. Aniridia is accompanied by an increased incidence of nephroblastoma. Cataract occur in many disorders among which galactosemia and fructosemia may be noted for their association with renal tubular acidosis. Examinations of the

fundus may reveal the ranges of hypertension with arterial narrowing, haemorrhage, exudates and papilloedema.

Ears: Deformities of the external ears are reported to be associated with renal anomalies. High tone senseineural deafness is characteristic of Alport's syndrome. Nerve deafness is also associated with some cases of distal renal tubular acidosis.

Musculoskeletal system: Muscle wasting is a feature of chronic uremia. The osteomalacic phase of uremic osteodystrophy is associated with muscle weakness as is hypophosphatemic rickets.

Skeleton: The classic features of rickets may be a consequence of the early osteomalacic phase of renal osteodystrophy or renal tubular acidosis.

Genu valgum is common with renal osteodysptrophy.

Congenital hip dislocation is common in infants with renal disease.

Joints: Arthropathy is a classic feature of SLE and Henoch-schonlein purpura nephritis and is occasionally observed in children with idiopathic membranous nephropathy.

Skin: examination of the skin may reveal the maculopapualr rash of Henoch-schonlein purpura, the painful

purple lesions involving the fingers and toes of vasculitis or the butterfly rash of SLE.

Multiple café au-lait Spots points to neurofibromatosis which may be associated with renal artery stenosis and hypertension.

1.4 The Epidemiology of Renal Diseases:

Socioeconomic, geographical and genetic factors play important roles in determining the prevalence and pattern of renal diseases in each part of the world. There is no doubt that local conditions in developing countries such as poverty, malnutrition, poor hygienic conditions and high rate of consanguinity, play a major role in the development of several renal diseases in childhood.

1.4.1 Renal diseases in neighbouring countries and around the world

In Pakistan: in 1992, Iqbal et al⁽⁴³⁾, studied the pattern of renal diseases in a total of 1298 patients with renal disease, 62.2% had urinary tract infection (UTI), 20.5% had nephrotic syndrome (NS), 13.1% of the admitted patients had acute renal failure due to various causes.

In China: in 1992, Zhang et al⁽⁴⁴⁾, studied the changing pattern of glomerular diseases in Chinese children, renal diseases accounted for 7.3% of the paediatric medical discharges, acute glomerulonephritis (GN) accounted for 30% of renal diagnoses, nephrotic syndrome for 28%, mortality in children with renal diseases was 0.4%.

The spectrum of renal diseases in Durban, South Africa⁽⁴⁵⁾, between 1985-1993 in a study involving 1787 patients, showed acute glomerulonephritis to account for 45%, nephrotic syndrome 22%, renal hypertension 8%, acute renal failure for 7%, chronic renal failure for 4%, haemolytic-uremic syndrome for 1.3%, chronic glomerulonephritis for 0.6%, vasculitis/Henochschonelin purpura nephritis for 0.75%, SLE nephritis for 0.3%.

In Nigeria: in 1994, Eke et al⁽⁴⁶⁾, investigated the prevalence and significance of renal diseases in a 5 years prospective study of 699 children with various renal diseases. Renal diseases accounted for 1.1% of the total outpatients and hospital admissions, UTI accounted for 68.9%, nephrotic syndrome for 14.6%, acute post streptococcal GN for 11.4%, Wilm's tumor for 1.6%, 8 of the 17 cases with obstructive uropathy were secondary to meatal stenosis following circumcision. 15 children developed end-stage renal failure mainly due to chronic glomerulonephritis.

In Jordan: in 1995⁽⁴⁷⁾, 599 patients with various renal diseases in Jordan University Hospital were analysed to give an overview of renal diseases in children in that country, 28.4% were found to have congenital and hereditary familial nephropathies, 22.3% had nephrotic syndrome, 17.3% had chronic renal failure, 11.7% had acute nephritis (including acute renal failure), 9.2% had chronic GN, 8.3% had tubulointerstitial and metabolic renal diseases and 2.8% had collagen vasculitis.

In South Korea, Choi et al⁽⁴⁸⁾, reviewed 4514 cases of renal biopsy collected in the period between 1973-1995 to evaluate the distribution and changing pattern of renal diseases, paediatric cases comprised 40.5%, M : F ratio was 1.1 : 1, the primary glomerulonephritis incidence rate were: minimal change disease 24.8%, IgA nephropathy 10.3%, post-streptococcal GN 8.6%, focal segmental glomerulosclerosis (FSGS) in 4%. The most common secondary GN in children was Henoch-Schonlein purpura nephritis. The most common causes of nephrotic syndrome in children was minimal change disease followed by membranous GN and FSGS.

In the United Arab Emirates, Taher et al⁽⁴⁹⁾, analysed 490 native kidney biopsy performed on patients presenting to 4 hospitals in the Emirate of Abu Dhabi from 1978 to 1996. The

most common indication for renal biopsy was the nephrotic syndrome (54%) followed by asymptomatic urinary abnormalities (29.7%) and chronic renal failure (12.7%). Primary glomerular diseases accounted for 77%, chronic proliferative glomerulonephritis as a group was the predominant pathology (36.2%) followed by idiopathic membranous glomerulopathy (20.1%), then focal segmental glomerulosclerosis 18.3%, minimal change nephropathy 18.3% and IgA nephropathy 6.3%. In the 187 patients with primary glomerular diseases who presented with nephrotic syndrome, idiopathic membranous glomerulopathy, proliferative GN and minimal change GN were found in almost equal proportion (28.3%, 26.6% and 26.2% respectively) with focal segmental glomerulosclerosis accounting for the bulk of the remainder (15.4%).

In Lebanon: in 1998, Barakat et al ⁽⁵⁰⁾, reviewed 118 renal biopsies performed on Lebanese children over a period of 6 years retrospectively. Acute nephropathy was seen in 9.6%, primary nephropathy in 45% and secondary glomerular diseases in 14.6%, tubulointersitital diseases in 7.7%, metabolic and hereditary diseases in 6.7% and end stage renal diseases in 5.8%.

In Senegal, Niang et al ⁽⁵¹⁾, analysed 115 renal biopsies performed in the Nephrology Department in Dakar from 1993-

1998, nephrotic syndrome was the main indication of biopsy. There were similar findings in other parts of the world ⁽⁵²⁻⁵⁵⁾. The primary nephropathies were found in 69.5% of the patients, secondary nephropathies in 23.5% and unclassified nephropathies in 7%. Of the primary nephropathies focal segmental glomerulosclerosis was found in 47% similar to the previous studies from the region ⁽⁵⁶⁻⁵⁷⁾, followed by membranous glomerulopathy in 12.5%. IgA nephropathy which is one of the most common nephropathies in Europe^(58,59) , is very rare in Dakar found only in 2% of all nephropathies. Secondary nephropathies were dominated by lupus nephritis followed by tubulointerstitial nephritis.

In the US (United States), kidney disease is a major cause of illness and death among infants, children and adolescents who make up about 25% of the US population ⁽⁶⁰⁾.

Each year an estimated 14,000 children have kidney disease, of those, 5000 have kidney failure and are on dialysis or have a kidney transplant, about 60% are 12 year or younger ^(61,62). 1.2 million Children under age 7 develop UTI ⁽⁶³⁾. 300,000 children required further testing after the doctor finds protein in the urine (an early sign of kidney disease) ⁽⁶⁴⁾. An estimated 120,000 people

under age 20 years have diabetes ⁽⁶⁵⁾, 40% of them will eventually develop kidney disease ⁽⁶⁶⁾.

76,000 children are treated for hypertension which often precedes kidney failure and a cardiovascular disease ⁽⁶⁷⁾.

20,000 babies are born with kidney abnormalities ⁽⁶⁸⁾.

2,000 infant die from a disease of the genitourinary tract ⁽⁶⁰⁾ .

According to the 1998 study by the North American Paediatric Renal Transplant Co-operative, the leading cause of chronic renal failure in children in United State are: urinary tract infection (Obstructive uropathy) in 23%, genetic renal diseases e.g. polycystic kidney disease, 19%, a plastic/hypoplastic dysplastic kidneys in 19%, Focal segmental glomerulosclerosis in 12% (FSGS is two times more common in African-American children compared to other groups), and reflux nephropthy in 9%.

In Venezuela, South America, in 1998 Orta et al ⁽⁶⁹⁾, studied the epidemiology of renal diseases in 3624 patients, 32% had UTI with detection of urinary tract abnormalities in 25% of them, metabolic disorders in 28% mainly idiopathic hypercalciuria and hyperuricosuria, glomularnephritis in 9.5%, renal stones in 7%, renal tubular acidosis in 5.6%, nephrotic syndrome in 4.5%, primary haematuria in 4.2%, acute renal failure in 2.8% (43% due to dehydration, 15% to birth asphyxia, 14% to septicaemia and 23%

to multiple factors), chronic renal failure in 1.6% (secondary to glomerulopathies predominantly FSGS, structural abnormalities of the urinary tract and hereditary diseases), and finally miscellaneous diseases in 4.8%.

In Spain, Rivera et al⁽⁷⁰⁾, obtained data from 7016 patients with biopsies renal diseases between 1994-1999, investigating the prevalence, incidence, clinical and histopathological data, a male predominance was seen for all age groups. The most common clinical syndrome at any age was nephrotic syndrome, in children the most frequent causes of nephropathies were minimal change disease, IgA nephropathy and focal segmental glomerulosclerosis.

In Lithuania, Loreta et al⁽⁷¹⁾, analysed 316 renal biopsies performed during the period of 1995-1999 in 5 nephrology centers of Lithuania. M : F ratio was 204 : 112, the main indications for renal biopsy were nephrotic syndrome 29.1%, haematuria and non-nephrotic proteinuria 27.8%. The leading causes of kidney damage were primary GN 69.3% which was 2.4 times more common in males than in females. The dominant types of primary GNs were IgA nephropathy 30.4%, membranoproliferative GN 26.8%, membranous nephropathy 10.3% and focal segmental glomerulosclerosis 9.8%. Renal amyloidosis was found in 8.6% of all renal biopsies.

In Saudi Arabia ⁽⁷²⁾, 200 renal biopsies performed between 1994-1999 at the King Khalid University Hospital, Riyadh, were analysed to obtain a comprehensive insight into the prevalence of glomerular diseases. Primary glomerular diseases account for 63.5% of all diseases, among the primary glomerular diseases, focal segmental glomerulosclerosis was the most common histological lesion accounting for 34.6% [similarly FSGS was the commonest lesion reported from Saudi Arabia by Quinibi et al ⁽⁷³⁾, Akhtar et al⁽⁷⁴⁾ and Mitwali et al ⁽⁷⁵⁾]. Mesangioproliferative glomerulonephritis was the second most common lesion in 25.1% followed by mesangiocapillary GN 15.7%, IgA nephropathy 10.2% and minimal change disease in 8.5%. Among 2ndry glomerular diseases, lupus nephritis was the most prevalent 24.5%.

In Jordan: in 1999 ⁽⁷⁶⁾, 350 renal biopsies at both the Jordan University Hospital and the Jordan Hospital, were analysed, there were 53.4% males and 46.6% females. Nephrotic syndrome was the main indication of biopsy as have been published previously ^(53,77). The nephrotic syndrome was the presenting feature in 55.4%, acute renal failure in 15.7%, haematuria and/or non-nephrotic proteinuria in 12.9%, chronic renal failure in 9.1% and haematuria alone in 6.9%. In the patients with nephrotic syndrome, 72.2% had primary form, in this group,

membranoproliferative GN was the most common pathology (35%) followed by focal segmental glomerulosclerosis (27.1%), these findings are comparable with a previous publication from Jordan ⁽⁵³⁾. Amyloidosis and SLE were the commonest findings among the patients with 2ndry nephrotic syndrome (40.7% and 38.8% respectively). The high prevalence of amyloidosis reported in this study is attributed to the high prevalence of familial Mediterranean fever (FMF) in Jordan (45.5% of amyloid cases were due to FMF). Rapidly progressive GN was seen in 34.5% of the patients presenting with acute renal failure while FSGS was seen in 25% of those with chronic renal failure. IgA nephropathy was the major finding among those presented with haematuria-proteinuria and those presented with isolated haematuria.

In the Islamic Republic of Iran, Ali D et al ⁽⁷⁸⁾, conducted a study on 1358 children with renal diseases admitted to Shiraz Paediatric Nephrology unit from 1993 to 2000 to see the spectrum of in-patients renal diseases in children in that country. 52% were boys and 48% were girls. 30% of the patients were below 2 yrs. Admission diagnoses were: acute nephritis in 23%, urinary tract infection in 19.1%, nephrotic syndrome in 18.6%, chronic renal failure in 14.9%, urologic problems in 7.5%, acute renal failure in 7.3%, metabolic disorders in 3.5% and hypertension in 2.9%.

Acute post-streptococcal nephritis was the most common disease in the acute nephritis group. Minimal change nephrotic syndrome was the most common in the nephrotic syndrome group (64.2%) but still this percentage is lower than that reported in other studies (79,80) and the high percentage of focal segmental glomerulosclerosis reported in another study was not seen in this study (81). Chronic renal failure was mainly due to urologic malformations (46%), followed by hereditary nephropathies and glomerulonephritis and these findings were very similar to the previous studies (82-85).

Acute renal failure was caused mainly by gastroenteritis and there were six cases of acute failure due to scorpion sting and this has been reported from Iran previously (86). Reflux nephropathy was the most common cause of persistent hypertension as was found in other studies (87,88).

In Iraq, Ikdam R et al (89), reviewed and categorized a series of 520 biopsies performed between 1994 and 2001 to evaluate the pattern of glomerular diseases in that country. Primary glomerular diseases accounted for 85.5%, 2ndry glomerular disease for 10.5% and miscellaneous disease for 4%. The primary glomerular disease included: Focal segmental glomerulosclerosis (26.3%), mesangial proliferative GN (22.5%), minimal change disease (17.1%),

membranoproliferative GN (16.2%), membranous GN (14.5%), rapidly progressive GN (3.4%). The secondary glomerular diseases included: lupus nephritis (45.5%), amyloidosis (27.3%), hereditary nephritis (10.9%) and hypertensive nephropathy (1.8%). The incidence of renal amyloidosis was relatively high in this study, however is similar to the incidence reported from the countries in the Middle East which is most probably related to the increased prevalence of familial Mediterranean fever (FMF) ⁽⁹⁰⁾.

In the Midwestern Zone of Nigeria, Ibasdin O et al ⁽⁹¹⁾, evaluated 195 children in the pediatric in-patient service at the University of Benin Teaching Hospital from 1997-2002 to document the pattern of childhood renal diseases in that part of the country, renal disease accounted for 4.5% of the total Pediatric admissions. Urinary Tract Infections (UTI) was found in 32.8%. The leading role of UTI found in this study had been noted in a previous study ⁽⁴⁶⁾. The majority of cases of UTI occurred in patients with other renal morbidities (nephrotic syndrome, acute GN and chronic renal failure), other workers have also reported the relationship between UTI and these disorders ⁽⁹²⁻⁹⁴⁾. The second most common morbidity encountered was nephrotic syndrome (24.4%) characterized by high incidence of associated UTI and steroid resistance. Acute glomerulonephritis occurred in 20.0%

complicated commonly by UTI and congestive cardiac failure, chronic renal failure in 9.6% and unlike reports on chronic renal failure from middle east ⁽⁹⁵⁾ and western world ⁽⁹⁶⁾, structural urologic malformations played a very dominant role in this study. Nephroblastoma found in 6.8%. Rare conditions included acute renal failure in 4.1%, urethral prolapse, vesico-ureteric reflux, polycystic kidney disease and urolithiasis.

1.4.2 Renal disease in Sudan:

In Sudan there were no previous study on the prevalence and the spectrum of renal diseases, all the studies done were to investigate individual renal problems:

Idris H. M, in 1983, ⁽⁹⁷⁾ studied the epidemiology, clinical picture, complications, treatment and prognosis of post-streptococcal GN in 42 children, 36 of them had acute GN following upper respiratory tract infections and 6 patients following pyoderma, the mean age was 8.5 yrs, M : F ratio was 2 : 1. All children recovered within 4 weeks and no deaths observed.

Mustafa W.E, in 1990, ⁽⁹⁸⁾ studied the prevalence of UTI in school girls, it was found to be 4.8%.

Haroun H.M. in 1990, ⁽⁹⁹⁾ studied the prevalence of UTI associated with urinary bilharziasis, no difference was found in the

prevalence of UTI between children with schistosoma haematobium and controls.

Ahmed A.B. in 1994, ⁽¹⁰⁰⁾, studied the frequency of UTI in symptomatic under five Sudanese children, significant bacteria was found in 17.2%, it was significantly more common in females, no significant age difference and E. coli was the commonest isolated organism.

Mohammed A. A. in 1998, ⁽¹⁰¹⁾ studied the clinical pattern and outcome of renal failure in Sudanese children, acute renal failure occur in 23% while chronic renal failure in 77% of the patient. The commonest causes of acute renal failure were: acute tubular necrosis (35%), acute GN (25%), posterior-urethral valves (15%), haemolytic uremic syndrome (10%) and sever dehydrations (10%). Causes of chronic renal failure were: chronic GN (52%), urinary calculi (7.5%), chronic pyelonephritis (4.5%), polycystic-kidney disease (4.5%), Alport's syndrome (3%), unidentified in 25.3%, 57.5% of the patients improved, 27.6% died and 14.9% lost their follow up.

Ali M. A. in 2003,⁽¹⁰²⁾ studied the clinical pattern of nephrotic syndrome and the immediate response to treatment in children. 68.6% of the patients were found to be steroid sensitive, renal biopsy done in 32.5%. The histopathological findings of the

biopsies were as follows: minimal change disease in (8.8%), focal segmental glomerulosclerosis in (20.6%), mesangial proliferative (5.9%), membranous GN (11.8%), membranoproliferative GN (11.8%), rapidly progressive GN in (17.6%), diffuse mesangial sclerosis in (2.9%), amyloidosis in (2.9%), SLE nephritis in (5.9%), proliferative GN in (11.8%). Chronic renal failure was observed in 11.4% of the patients while acute renal failure occurred in 6.7%. Mortality was 3.8%.

Orainib HE, in 2004⁽¹⁰³⁾, studied the psychosocial impact of CRF on children and their families. 17 (34%) of her patients, had behavioural problem (94%) of them were receiving renal replacement therapy. 59.5% left school and 40% had restricted daily activities.

Mohamed BA, in 2004⁽¹⁰⁴⁾, studied the spectrum of renal bone disease in children with CRF. Renal osteodystrophy was documented in 36 (63.1%), with secondary hyperparathyroidism being the predominant pattern of it.

Iman HK, Babiker GK, Salma MS⁽¹⁰⁵⁾, et al analyzed 172 renal biopsies to document the pattern of GN in Sudan. The commonest causes of primary GN: FSGS (26.6%) membranoproliferative GN (22.1%), minimal change disease in (10.5%). Lupus nephritis was the commonest cause of secondary GN (11.6%).

◆ JUSTIFICATION

- Renal diseases are becoming a serious problem in the recent years leading to significant increase in morbidity and mortality of children.
- Identification of the profile of renal diseases in a particular geographical region helps in the recognition of specific risk factors & subsequent planning for adequate prevention.
- No study was done before to see the pattern of renal diseases in Sudanese children.

◆ OBJECTIVES

The study aims to:

- Document the pattern and short-term outcome of renal diseases among children admitted to Paediatric and renal units in Khartoum State.
- To analyze the associated and background factor for different entities of renal diseases.

CHAPTER TWO

2. PATIENTS AND METHODS

2.1 Patients

2.1.1 Nature of the study:

Is a prospective, descriptive hospital based study.

2.1.2 Study area:

The study was conducted on patients admitted to the major hospitals in Khartoum state, this includes:

- Khartoum Children Emergency Hospital.
- Khartoum Teaching Hospital.
- Soba University Hospital.
- Ahmed Gasim Hospital.
- Omdurman Children Emergency Hospital.

2.1.3 Duration of the study

The data was collected over a period of six months, from January 2004 to June 2004.

2.1.4 Study population:

The study population included all children of both sex, from day one to 18 years of age who were admitted to the major hospitals mentioned with a renal problem.

2.1.5 Sample size:

The sample size was calculated according to the formula:

$$n = z^2 \times pq/d^2$$

Where:

n = sample size

Z = 1.96% (at 95% level of confidence)

p = prevalence

q = 1 – P

d = 0.05 (desired margin of error)

The calculated sample size was 150

2.1.6 Inclusion criteria:

All children (birth – 18 years) admitted with a renal problem.

2.1.7 Exclusion criteria:

- Those who have no clear final diagnosis.
- Refused consent.

2.1.8 Data collection technique:

The data from each child included in the study was recorded in a designed questionnaire containing personal details as age, gender, tribe, social class, presenting symptoms and signs and final diagnosis, then for each diagnosis more data was recorded for example if the diagnosis was urinary tract infection (UTI), if it occurred as an isolated problem or associated with an underlying

congenital or acquired renal problem, and also if it was associated with normal or impaired renal function.

If the diagnosis was nephrotic syndrome, if it was steroid sensitive or resistant and the underlying pathology in the steroid resistant variety.

If the diagnosis was renal failure, if it was acute or chronic and the underlying cause in each case. And so on for the rest of the diagnosis.

2.1.9 Methodology:-

For all children admitted with renal problem, verbal consent was obtained, then the following was done:-

- 1- Completing the questionnaire.
- 2- Physical examination was done by the author concentrating on signs of renal diseases.
- 3- Investigations were done: some investigations were done to all patients and some were done according to the needs.
- Investigations were done by the units responsible for the patients.

Investigation done to all patients: e.g.

- Urine analysis
- Urine for culture and sensitivity.
- Urea, creatinine and electrolytes.

- Ultrasound abdomen.
- **Investigations done according to the need: e.g.**
 - Urine for 24 hours protein.
 - Serum albumin.
 - ASO titre.
 - Intravenous Urography (IVU).
 - Mecturating cystourethrography (MCUG).
 - Renal biopsy.
 - Renal scanning
 - CXR
 - Skeletal survey

* The patients then were followed up till final short outcome was known.

2.1.10 Ethical consideration:

- Verbal consent was taken from the administrator of each hospital.
- Consent was taken from the patient and the parents.
- Consent of the doctor in charge.

2.1.11 Statistics:

Data were entered into SPSS (statistical package for social science) computerized program for analysis, chi-square and Yates correction tests were used and P value less than 0.05 was considered significant.

Definitions:

- I- ***Steroid-resistance***: Failure to achieve response in spite of 4 weeks prednisolone 60 mg/m²/day.
- II- ***Normal blood pressure***: average systolic and diastolic blood pressure below the 90th percentile for age, gender and height.
- III- ***Hypertension***: average systolic or average diastolic blood pressure greater than the 95th percentile for age, gender and height.
- IV- ***Acute renal failure***: is the sudden deterioration in renal function result in the inability of the kidneys to maintain fluid and electrolyte homeostasis.
- V- ***Chronic renal failure***: is defined as an irreversible reduction in GFR and it can be classified according to the GFR into:

Mild: GFR 50-75 ml/min/m²

Moderate: GFR 25-50 ml/min/m²

Sever: GFR 10-25 ml/min/m²

End stage renal disease (ESRD): GFR < 10 ml/min/m²

Chapter Three

3- RESULTS

During the period from January 2004 to June 2004, 150 patients with different renal diseases were studied in the major hospitals in Khartoum State.

The main renal diseases found in the studied group were: urinary tract infections (UTI) in 57 patients (25.2%), nephrotic syndrome in 34 (15.1%), renal stones 31 (13.7%), CRF 30 (13.3%), congenital anomalies 28 (12.5%), acute GN 24 (10.6%), acute renal failure 12 (5.3%).

3.1 Demographic Characteristics:

3.1.1 Age: The age of the study group ranged from one day – 18 years with a mean age of 6 ± 2.1 SD, the most commonly affected age group 58 (38.7%) were children aged 5 – 10 years and the least affected group 22 (14.6%) were those below one year. Age distribution of the study group is shown in *(Figure 1)*.

3.1.2 Gender: The majority of patients were males 105 (70%), females constituted only 30%. M : F ratio was 2.3 : 1. Sex distribution is shown in *(Figure 2)*.

3.1.3 Region of origin: Most patients originally came from the northern part of the country 56(37.3%) followed by the western part 48(32%), patients from eastern part were the least 3(2.0%). Distributions by region of origin is shown in *(Figure 3)*.

2. Presenting Symptoms and Signs:

A hundred & thirteen (75.3%) patients presented with symptoms specific to renal disease, while 37 (24.7%) presented with non-specific symptoms.

The commonest specific symptoms included: generalized or facial swelling in 60 patients (37.9%), red or dark urine 36(22.8%), burning micturition 28(17.7%), oliguria 9(5.7%) abnormal urinary stream 9(5.7%), loin pain 7(4.4%). The rest of specific symptoms is presented in *(Table 1)*.

The commonest presenting non specific symptoms included: vomiting in 14 patients (25.0%), fever 13(23.2%), abdominal distension 8(14.4%), diarrhea 7(12.5%), convulsions 4(7.1%), general ill-health 4(7.1%), refusal of feeding 4(7.1%) and headache 2(3.6%). *(Table 2)*

Table (1): Specific presenting symptoms in the study group

n = 113

Symptoms	Frequency	Percentage (%)
Generalized or facial swelling	60	37.9
Red or dark urine	36	22.8
Burning micturition	28	17.7
Oliguria	9	5.7
Abnormal urinary stream	9	5.7
Loin pain	7	4.4
A defect in lower abd. Wall with urine dripping	3	1.9
Urine retention	2	1.2
Urine incontinence	2	1.2
Suprapubic pain	1	0.6
Increase urinary frequency	1	0.6

Table (2): Non-specific presenting symptoms in the study group

n = 37

Symptoms	Frequency	Percentage (%)
Vomiting	14	25.0
Fever	13	23.2
Abd-distension	8	14.4
Diarrhea	7	12.5
Convulsion	4	7.1
General ill health	4	7.1
Refusal of feeding	4	7.1
Headache	2	3.6

The commonest presenting signs included: generalized or facial oedema 71(33.2%), high blood pressure 65(30.4%). There were 23(10.7%), patients with no signs, other presenting signs are shown in *(Table 3)*.

3.3 Various Renal Disorders in the Study Group:

There were 226 renal diseases that occurred in 150 patients, they were as follow: UTI in 57(25.2%), nephrotic syndrome 34(15.1%), renal stones 31(13.7%), CRF 30 (13.3%), congenital anomalies 28(12.5%), acute GN 24(10.6%), ARF 12 (5.3%), tumors 5 (2.2%). The rest of diseases are shown in *(Table 4)*.

3.4 Specific Renal Disease Enteties:

3.4.1 UTI:

UTI either as an isolated diagnosis or in association with other pathology was seen in 57(25.2%) patients. Only 3(5.3%) were isolated cases while 54(94.7%) occurred in association with other diseases, the details of this is shown in *(Table 5)*.

Table (3): Presenting signs in the study group**n = 150**

Sign	Frequency	Percentage (%)
Generalized or facial oedema	71	33.2
High blood pressure	65	30.4
No signs	23	10.7
Fever	12	5.6
Palpable kidneys/kidney	9	4.2
Abdominal mass	7	3.3
Abnormal urethral opening	7	3.3
Disturbed level of consciousness	6	2.8
Defect in the abdominal wall	3	1.4
Others	11	5.1

Table (4): Frequency distribution of childhood renal disorders in the study group

n = 150

Diagnosis	Frequency	Percentage (%)
UTI	57	25.2
Nephrotic syndrome	34	15.1
Renal stones	31	13.7
CRF	30	13.3
Congenital anomalies	28	12.5
Acute glomerulonephritis	24	10.6
ARF	12	5.3
Renal tumors	5	2.2
Renal tubular acidosis	3	1.3
Nephrocalcinosis	1	0.4
Bladder polyp	1	0.4
Total	226	100.0

Table (5): Total number of patients with UTI

Diagnosis	Frequency	Percentage (%)
UTI with stones	24	42.1
UTI with acute GN	13	22.8
UTI with congenital anomalies	9	15.8
UTI with nephrotic syndrome	8	14.0
Isolated UTI	3	5.3
Total	57	100.0

3.4.2 Nephrotic syndrome:

3.4.2.1 Steroid sensitivity:

34 patients were diagnosed as nephrotic syndrome, 2 had congenital NS and they didn't receive steroids. 32 patients were given steroids, out of them 21 patients (65.6%) were steroid sensitive (i.e they responded to steroids alone in form of disappearance of oedema and proteinuria), whereas 11 (34.4%) were diagnosed as steroid resistant (This diagnosis was made only upon failure to achieve response inspite of 4 weeks prednisolone 60-80 mg/m²/day). (*Figure 5*)

3.4.2.2 Histopathologic profile of patients with steroid resistant NS:

Renal biopsy was done in the 11 patients diagnosed as steroid resistant; the histopathologic findings were as follows: 7 patients (63.6%) had focal segmental glomerulosclerosis (FSGS), and 4 (36.4%) had mesangiocapillary GN. (*Figure 6*)

3.4.2.3 Age of steroid sensitive patients VS steroid resistant:

No significant correlation was found on comparing age of steroid sensitive patient with steroid resistant. P value = 0.151 (*Table 6*).

Table (6): Age of steroid sensitive patient compared with steroid resistant patients

Age (yrs)	Steroid sensitive	Steroid resistant	Total
1 - < 5	5 (23.8%)	1 (9.1%)	6
5 – 10	14 (66.7%)	6 (54.5%)	20
> 10	2 (9.5%)	4 (36.4%)	6
Total	21 (100.0%)	11 (100.0%)	32

P value = 0.151

3.4.2.4 *Blood pressure of steroid sensitive patients VS steroid resistant:*

85.7% of steroid sensitive patients had normal blood pressure and (14.3%) had high blood pressure, while 81.8% of steroid resistant patient had high blood pressure and 18.25 had normal BP. A significant correlations was found between the blood pressure and steroid sensitivity. P value = 0.0007 (*Table 7*)

3.4.2.5 *Haematuria in steroid sensitive patients VS steroid resistant:*

No significant correlation was found between the presence or absence of haematuria and steroid sensitivity. P value = 0.573

3.4.3 Renal Stones:

3.4.3.1 *Site of involvement by stones:*

Of the 31 patients with renal stones, 10 patients (32.2%) had vesical stone/stones, 9 (29.0%) had stone/stones in one kidney, 8 (25.8%) had stone/stones in both kidneys, 2(6.5%) had urethral stones and 2 (6.5%) had stones in multiple sites of the urinary tract. (*Figure 7*)

A significant correlation was found between the patient ages and site of renal stones. P value = 0.014

**Table (7): Blood pressures of steroid sensitive patients
compared with steroid resistant**

Blood pressure	Steroid sensitive	Steroid resistant	Total
High	3 (14.3%)	9 (81.8%)	12
Normal	18 (85.7%)	2 (18.2%)	20
Total	21 (100.0%)	11 (100.0%)	32

P value = 0.0007

No significant correlation was found between the social class of patient and the site of stone. P value = 0.971

A significant correlation was found between the site of stones and renal function. P value = 0.018 (*Table 8*).

A significant correlation was found between patients' ages and the outcome. P value = 0.013 .

3.4.4 Renal failure: Renal failure occurred in 42 patients. 12 (28.8%) had acute renal failure while 30 (71.2%) had chronic renal failure: of the 30 patients with chronic renal failure 8 were diagnosed at presentation as CRF whereas the other 22 found to have CFR as the final outcome of the other diseases.

3.4.4.1 Causes of acute renal failure:

The main cause was hypovolemia 6 (50%) due mainly to severe dehydration. Other causes are shown in (*Figure 8*).

3.4.4.2 Causes of chronic renal failure (CRF)

CRF complicating renal stones occurred in 10 (33.3%), chronic GN 7 (23.3%), posterior urethral valve 5 (16.7%), unknown cause 3 (10%). The rest of causes are presented in (*Table 9*)

Table (8): Site of renal stone VS renal function

Site	Renal function		Total
	Normal	Impaired	
Vesical	7 (36.8%)	3 (25%)	10
One kidney	7 (36.8%)	2 (16.7%)	9
Both kidney	1 (5.4%)	7 (58.3%)	8
Urethral	2 (10.5%)	0	2
Multiple sites	2 (10.5%)	0	2
Total	19 (100.0%)	12 (100.0%)	31

P value = 0.018

Table (9): Causes of chronic renal failure in the study group

Cause	Frequency	Percentage (%)
Renal stones	10	33.3
Chronic GN	7	23.3
Posterior urethral valve	5	16.7
Unknown	3	10.0
Dysplastic kidney	2	6.8
Polycystic kidney	1	3.3
Hydronephrosis	1	3.3
Nephrocalcinosis	1	3.3
Total	30	100.0

3.4.5 Congenital Anomalies:

3.4.5.1 Types of congenital anomalies in the study group:

Posterior urethral valve was the most common congenital anomaly detected 10 (35.7%) and in 9 patients it was complicated by vesicouretric reflux (VUG). Hypospadias occurred in 6(21.4%) dysplastic kidneys in 4(14.3%), it was bilateral in one patient and unilateral in the other 3. ectopia vesica 3 (10.7%) polycystic kidney disease 2 (7.1%), it was bilateral in one patient and unilateral in the other, hydronephrosis 2 (7.1%), it was bilateral in both patients, in one of them associated with ureteropelvic junction obstruction, in the other patient the cause was unknown, and finally epispadia occurred in 1 (3.6%). (*Table 10*).

3.4.5.2 Type of congenital anomaly VS renal functions of the patients:

No significant correlation was found between the type of congenital anomaly and the renal function of the patients. P value = 0.19 (*Table 11*)

Table (10): Types of urinary tract anomalies in the study group

Type	Frequency	Percentage (%)
Posterior urethral valve	10	35.7
Hypospadia	6	21.4
Renal aplasia or dysplasia	4	14.3
Ectopia vesica	3	10.7
Polycystic kidney disease	2	7.1
Hydronephrosis	2	7.1
Epispadia	1	3.6
Total	28	100.0

Table (11): Type of congenital anomaly VS renal function of the patients

Type	Renal function		Total
	Normal	Impaired	
Posterior urethral valve	5 (26.3%)	5 (55.6%)	10
Hypospadia and episphadia	7 (36.8%)	0	7
Renal aplasia or dysplasia	2 (10.5%)	2 (22.2%)	4
Ectopia vesica	3 (15.8%)	0	3
Polycystic kidney disease	1 (5.3%)	1 (11.1%)	2
Hydronephrosis	1 (5.3%)	1 (11.1%)	2
Total	19 (100.0%)	9 (100.0%)	28

P value = 0.19

3.4.6 Acute glomerulonephritis:

3.4.6.1 Types:

Of the 24 patients with acute GN, 21 (87.5%) were diagnosed as post infections GN, this diagnosis was made depending mainly on the clinical presentation (oedema, haematuria, oliguria) preceded by throat or skin infection, supported the clinical diagnosis laboratory finding especially of ASO titre of more than 200, and that the course of the disease goes towards recovery within one month. No biopsy was done in one of them. The remaining three patients with acute GN were diagnosed by renal biopsy as follows: 2(8.3%) found to have rapidly progressive GN and one patient (4.2%) had acute membranoproliferative GN. *(Figure 9)*

No significant correlation was found between the age of patients and the type of acute GN. P value = 1.180.

Also no significant correlation was found between the ASO titre and the types of acute GN. P value = 0.396.

Strong correlation was found between the outcome and the type of acute GN. P value = 0.000006.

3.4.7 Outcome:

Short-term outcome of patients in the study group: At the end of the study, 91 patients (60.7%) achieved full recovery, 43(28.6%) progressed to a chronic renal problem (chronic renal failure or persistent proteinuria and/or haematuria, 9(6%) died and 7(4.7%) referred to other units e.g. for chemotherapy in patients with renal tumors. (*Figure 10*)

3.4.7.1 The details of the outcome for each diagnosis: (*Table 12*)

Among the 34 patients with nephrotic syndrome, 21 patients were fully recovered, 10 patients progressed to a chronic renal problem (of those, 2 developed chronic renal failure and 8 had persistent proteinuria and/or haematuria). The two patients with congenital nephrotic syndrome were both died.

In the 31 patients with renal stone: 21 patients had full recovery while 10 patients ended with chronic renal failure.

Of the 28 patients with congenital anomalies: 14 patients recovered, 9 progressed to chronic renal failure and one patient with bilateral hydronephrosis died of unknown cause.

In the 24 patients with acute GN: 21 patients fully recovered, 2 patients with rapidly progressive GN died and one patient progressed to chronic renal failure.

In the 20 patients with renal failure: 10 patients fully recovered, 8 had chronic renal failure (one of them died) plus two patients with acute renal failure also died.

For the other renal problems: one patient fully recovered, 5 patients progressed to a chronic renal problem and 4 patients referred to other units (For chemotherapy).

The total number of patients ended with chronic renal failure were 30 patients out of the 150.

3.4.8 Pattern of renal diseases in the study group

VS age groups:

There is a significant relation between the pattern of renal diseases and the age. P value = 0.001. *(Table 13)*

3.4.9 Pattern of renal diseases in the study group

VS gender:

No significant relation was found between the pattern of renal diseases and gender. P value = 0.211. *(Table 14)*

Table (12): The detailed outcome for each diagnosis:

Diagnosis	Outcome				Total
	Full recovery	Progressed to chronic problem	Died	Referred to other units	
Nephrotic syndrome	21 (23.1%)	10 (23.8%)	3 (33.3%)	-	34 (22.8%)
Renal stones	21 (23.1%)	10 (23.8%)	-	-	31 (20.8%)
Congenital anomalies	14 (23.1%)	9 (21.4%)	1 (11.1%)	3 (42.9%)	27 (18.1%)
Acute glomerulonephritis	21(11.0%)	1 (2.4%)	2 (22.2%)	-	24 (16.1%)
Renal failure	10 (11.0%)	7 (16.7%)	3 (33.3%)	-	20 (13.4%)
Renal tumors	-	1 (2.4%)	-	4 (57.1%)	5 (3.4%)
Isolated UTI	3 (3.3%)	-	-	-	3 (2.0%)
Renal tubular acidosis	-	3 (7.1%)	-	-	3 (2.0%)
Nephrocalcinosis	-	1 (2.4%)	-	-	1 (0.7%)
Bladder polyp	1 (1.1%)	-	-	-	1 (0.7%)
Total	91 (100%)	42 (100%)	9 (100%)	7 (100%)	149 (100%)

P value = 0.0001

Table (13): Pattern of renal diseases VS age groups:

Diagnosis	Age groups (Yrs)				Total
	1	1-5	5-10	> 10	
Nephrotic syndrome	2 (9%)	5 (13.2)	21(36.2%)	6 (18.8%)	34(22.7%)
Renal stones	2 (9%)	14(36.8%)	9 (15.5%)	6 (18.8%)	31(20.7%)
Congenital anomalies	10 (45.6%)	8 (21.1%)	8 (13.8%)	2 (6.3%)	28(18.7%)
Acute glomerulo-nephritis	-	5 (13.2%)	12(20.7%)	7 (21.9%)	24(16.0%)
Renal failure	4 (18.2%)	1 (2.6%)	6 (10.3%)	9 (28.1%)	20(13.3%)
Renal tumors	-	3 (7.9%)	1 (1.7%)	1 (3.1%)	5 (3.3%)
Isolated UTI	3 (13.6%)	-	-	-	3 (2.0%)
Renal tubular acidosis	1 (4.5%)	1 (2.6%)	-	1 (3.1%)	3 (2.0%)
Nephrocalcinosis	-	-	1 (1.7%)	-	1(0.7%)
Bladder polyp	-	1 (2.6%)	-	-	1(0.7%)
Total	22	38	58	32	150
	(100.0%)	(100.0%)	(100.0%)	(100.0%)	(100.0%)

P value = 0.0001

Table (14): Pattern of renal diseases VS gender:

Diagnosis	Gender		Total
	Male	Female	
Nephrotic syndrome	22 (21.0%)	12 (26.7%)	34 (22.7%)
Renal stones	24 (22.9%)	7(15.6%)	31 (20.7%)
Congenital anomalies	25 (23.8%)	3 (6.7%)	28 (18.7%)
Acute glomerulonephritis	15 (14.3%)	9 (20.0%)	24 (16.0%)
Renal failure	11 (10.5%)	9 (20.0%)	20 (13.3%)
Renal tumors	3 (2.9%)	2 (4.4%)	5 (3.3%)
Isolated UTI	1 (1.0%)	2 (4.4%)	3 (2.0%)
Renal tubular acidosis	2 (1.9%)	1 (2.2%)	3 (2.0%)
Nephrocalcinosis	1 (1.0%)	-	1 (0.7%)
Bladder polyp	1 (1.0%)	-	1 (0.7%)
Total	105	45	150
	(100.0%)	(100.0%)	(100.0%)

P value = 0.211

Chapter Four

4- DISCUSSION

The main renal disorders found in our study were:

UTI in 57 (25.2%), nephrotic syndrome 34 (15.1%), renal stones 31 (13.7%), CRF 30 (13.3%), congenital anomalies in 28 (12.5%), acute glomerulonephritis in 24(10.6%), acute renal failure 12 (5.3%), renal tumors 5 (2.2%), renal tubular acidosis 3 (1.3%) and one case of nephrocalcinosis (0.4%) and bladder polyp (0.4%).

This pattern is more or less similar to that reported from neighboring countries and some countries around the world.

UTI was reported to be the most common renal disease from western zone of Nigeria⁽⁹¹⁾ (32.8%), and Venezuela⁽⁶⁹⁾ (32%), and even higher percentage of UTI was reported from the Eastern part of Nigeria⁽⁴⁶⁾ (68.9%) and from Pakistan (65.2%)⁽⁴³⁾.

Nephrotic syndrome came next to UTI as in our finding in both Western⁽⁹¹⁾ and Eastern⁽⁴⁶⁾ parts of Nigeria (24.4%) and (14.6%) respectively and in Pakistan⁽⁴³⁾ (20.5%)⁽⁴³⁾ , while it was reported to be the most common renal disease from Spain⁽⁷⁰⁾ and South Korea (24.8%)⁽⁴⁸⁾.

Acute glomerulonephritis was reported to be the most common renal disease from China (30%)⁽⁴⁴⁾, South Africa (45%)⁽⁴⁵⁾

and from Iran (23%)⁽⁷⁸⁾, followed by nephrotic syndrome in China (28%)⁽⁴⁴⁾ and South Africa (22%)⁽⁴⁵⁾ and by UTI (19.1%) and then nephrotic syndrome (18.6%) in Iran⁽⁷⁸⁾.

In Jordan, congenital and heredofamilial disorders were reported to be the most renal disease (28.4%), followed by nephrotic syndrome (19.6%)⁽⁴⁷⁾.

Renal diseases were found to be more common in males (70.0%) with M.F ratio of 2.3 : 1, a comparable finding was reported from South Korea⁽⁴⁸⁾, Spain⁽⁷⁰⁾, Lithuania⁽⁷¹⁾, Jordan⁽⁷⁶⁾ and Iran⁽⁷⁸⁾. The predominance of males has been reported previously in Sudanese children with chronic renal failure by Mohammed B.A. in 2004⁽¹⁰⁴⁾. This predominance of males may be due to the fact that the major renal diseases like nephrotic syndrome and the majority of structural anomalies are more common in males than females.

The most commonly affected age group 58 (38.7%) were children between 5-10 years.

Most patients 56 (37.3%) come from the Northern part of the country, this was also reported previously in children with chronic renal failure (40.4%) by Mohammed B.A.⁽¹⁰⁴⁾, while Amani A.M., in her study in 1998 reported that most children (with acute and chronic renal failure), were from the capital Khartoum (28.8%)⁽¹⁰¹⁾.

This may reflect the improvement of health services in the capital Khartoum and the improvement of communication between different parts of the country.

The majority of patients 113 (75.3%), presented with symptoms specific to renal disease like generalized or facial swelling, haematuria, burning micturition, oliguria..etc. This is good because it helps in early diagnosis and subsequent early intervention to prevent complications.

In patients with UTI, only 3 cases (5.3%) were isolated UTI, this is because such patients are treated as outpatients and not admitted to hospital unless an underlying cause is suspected. But UTI was documented in association with other diseases like nephrotic syndrome, acute GN, renal stone and congenital anomalies in 54 patients (94.7%), the same pattern like ours was reported from Western Nigeria where out of 82 patients with UTI only 6 (7.3%) were isolated while 76 (92.7%) occurred in association with other diseases like nephrotic syndrome, acute GN and renal failure⁽⁹¹⁾.

The majority of children with nephrotic syndrome (65.6%) were found to be steroid sensitive, this is similar to the pattern reported from Libya⁽¹⁰⁶⁾, Ghana⁽¹⁰⁷⁾, Zimbabwe⁽¹⁰⁸⁾, Spain⁽⁷⁰⁾ and Iran⁽⁷⁸⁾. It was also reported previously in Sudanese children with

nephrotic syndrome by Motaz A.A. in 2003 when he studied the clinical pattern of nephrotic syndrome and the immediate response to treatment, he found that (68.6%) were steroid sensitive⁽¹⁰²⁾.

In patients with steroid resistant nephrotic syndrome 63.6% had focal segmental glomerulosclerosis (FSGS), the emergence of FSGS as the main cause of steroid resistant nephrotic syndrome was reported from Senegal^{51,50,57}, Saudi Arabia⁽⁷²⁻⁷⁵⁾ and Iraq⁽⁸⁹⁾. FSGS as the main cause of steroid resistant nephrotic syndrome, has been reported previously in Sudanese children by Motaz A.A⁽¹⁰²⁾. Eman H.K, Babikir G.K, Salma M.S and others also reported FSGS to be the most common primary glomerulonephritis in Sudanese patients⁽¹⁰⁵⁾.

No significant correlation was found between the age of the patients and steroid sensitivity (P. value : 0.151), and between the presence or absence of haematuria and steroid sensitivity (P. value : 0.573), however, strong correlation was found between the blood pressure and steroid sensitivity (P. value : 0.0007).

A high percentage of renal stones was reported in 31(13.7%) patients. This is higher than reports from other countries and renal stones was described to be one of the rare conditions from Nigeria⁽⁹¹⁾. Renal stones was found to be the main cause of CRF in our patients (33.3%), This may be due to either delay in diagnosis&

treatment or the late presentation of our patients to hospitals due to parental ignorance and that Sudanese people specially those from rural areas do not usually come to hospitals till they become very ill wasting time in traditional management.

Bladder stone was the commonest type (32.2%), followed by stone in one kidney and then in both kidneys, a significant correlation was found between the patient age and site of stone (P. value : 0.014), between the age and the outcome (P. value : 0.013) and between site of stone and renal function (P. value : 0.018). no relation was found between the site of renal stone and the social class of the patient.

Chronic renal failure accounted for (13.3%) of renal diseases and caused mainly by obstructive uropathy due to renal stones and posterior urethral valve (50.0%), this is unlike the finding of Amani A.M in 1998, she reported the main cause of CRF in her studied patients to be chronic glomerulonephritis (52%)⁽¹⁰¹⁾, and unlike the finding of Mohammed BA in 2004, who found the main cause of CRF to be unknown (49%), followed by obstructive uropathy (22.8%)⁽¹⁰⁴⁾. This difference may be due to the fact that in this study I included patients in surgical and urologic wards while others did not.

In the United States of America, obstructive uropathy was reported to be in one of the main causes of CRF in children (23%)⁽⁶⁰⁾. In Saudi Arabia, the annual incidence of CRF in children was 7.1% and the main cause was found to be malformations of the urinary tract (45.3%)⁽¹⁰⁹⁾, in Iran, CRF accounted for 14.9% in one study and the main cause was reported to be urologic malformations (49%)⁽⁷⁸⁾. In Nigeria, the annual incidence of CRF was 1.7% and the main cause was chronic GN (58.3%), followed by posterior urethral valve (33.3%)⁽¹¹⁰⁾. In Venezuela, CRF occur in 1,6% mainly secondary to FSGS and structural abnormalities⁽⁶⁹⁾. The differences between our findings and these reports may be due to the fact that the majority of these reports were from specialized renal centers while ours were from general paediatric units.

Acute renal failure occurred in 12 patients (5.3%), caused mainly by hypovolemia due to severe dehydration (50.0%), Amani A.M in her study, reported the main cause of acute renal failure to be acute tubular necrosis (35%), severe dehydration accounted only for 10% of the causes.⁽¹⁰¹⁾ a comparable finding to ours was reported from Nigeria⁽⁹¹⁾. In Venezuelan, acute renal failure accounted for 2.8% and was due mainly to severe dehydration. In Iran, acute renal failure accounted for 7.3% and the main cause was severe dehydration⁽⁷⁸⁾.

Congenital urinary tract anomalies were detected in 28 patients (18.7%), a higher percentage (28.4%), was reported from Jordan⁽⁴⁷⁾, where congenital and hereditifamilial diseases were found to be the most common renal disease and they attributed that finding to the higher rate of consanguineous marriages in that country, the majority of children in the report from Jordan were found to have primary vesicoureteric reflux (VUR), which in contrast, was not detected in one single patient in our study, all the cases of VUR were secondary to for example posterior urethral valve.

In the United States, 20,000 babies were born with kidney abnormalities each year⁽⁶⁸⁾, and these anomalies were found to be among the most common causes of chronic renal failure in that country⁽⁶⁰⁾.

The most common congenital anomaly detected in our patients was posterior urethral valve (35.7%), which accounted for (16.7%) of the causes of CRF.

No significant correlation was found between the type of congenital anomaly and the renal function (P. value : 0.19).

Acute glomerulonephritis accounted for (10.6%) of renal diseases, a higher percentage was reported from South Africa (45%)⁽⁴⁵⁾, China (30%)⁽⁴⁴⁾, and Iran (23%)⁽⁷⁸⁾. 87.5% of children

with acute glomerulonephritis had the post-infections form, a similar finding was reported from Iran⁽⁷⁸⁾ and Jordan⁽⁴⁷⁾. Associated UTI was found in the majority of patients with acute GN (54.2%), a similar association was reported from Nigeria⁽⁹¹⁾. All children with acute post-infections GN had full recovery, this favourable outcome was reported from Sudanese children previously in the study done by Haroun MI in 1993⁽⁴⁷⁾. In our study a strong correlation was found between the type of acute GN and the outcome (P. value : 0.000006).

No significant correlation was found between the patient age and the type of acute GN, (P. value : 0.180), and between the ASO titer and the type of acute GN, (P. value : 0.396).

Nephroblastoma occurred in 4 patients (1.8%), a similar finding was reported from Eastern part of Nigeria while a higher percentage of nephroblastoma (6.8%) was reported from Western part of Nigeria⁽⁹¹⁾.

Rare conditions reported included renal tubular acidosis (1.3%), nephrocalcinosis (0.4%) and bladder polyp (0.4%).

Outcome analysis showed that the majority of patients 91 (60.7%) recovered fully, a significant number 43(28.6%) progressed to a chronic renal problem of whom 30 developed chronic renal failure. The larger number of those who progressed

to CRF were patients with renal stones and congenital anomalies like posterior urethral valve, this indicates the late presentation of our patients to hospitals, because renal failure in both conditions is preventable.

◆ CONCLUSIONS

- The pattern of renal disease in our children is similar to the pattern reported from the neighboring countries and some countries around the world.
- Urinary tract infection (UTI), isolated and in association with other diseases, was the most common renal disease in our patients.
- Steroid sensitive nephrotic syndrome was the commonest type of nephrotic syndrome found and focal segmental glomerulosclerosis was the main cause of steroid resistance.
- Renal stone was a very common problem among our children and it was the main cause of chronic renal failure.
- The most common type of congenital urinary tract anomaly detected in the studied group, was posterior urethral valve and it was found to be one of the main causes of chronic renal failure among them.
- Post-infections glomerulonephritis was the commonest type of acute GN found and it had an excellent outcome.
- Renal diseases are common among our children and chronic renal failure was caused mainly by preventable conditions.

◆ RECOMMENDATIONS

- UTI should be considered and investigated in any child particularly infants and young children with unexplained fever.
- The initial management of any child with UTI must include imaging of the urinary tract and long term follow up is needed.
- Since FSGS was reported many times to be the most common cause of steroid resistant nephrotic syndrome, renal biopsy should be considered early in children who do not show steroid sensitivity.
- Careful investigation of children with repeated UTI, unexplained haematuria, recurrent loin pain and family history of renal diseases, for early detection of stones and congenital anomalies.
- Further studies should also be done on renal stones to explore the possible association of factors such as climate, dietary habits, familial and socio-economic status, which could shed some light on the problem.
- Renal diseases among children in our country should be taken seriously and dealt with through programmed health services and this will be a major step towards improvement of the health status and well-being in the community.

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